इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 2628-1 (1964): Rotary Wafer Switches (Low Current Rating) - Part I : Tests and General Requirements [LITD 3: Electromechanical COmponents and Mechnical Structures for Electronic Equipment]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA
JURIS
NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 2628 (Part I) - 1964
(Reaffirmed 2002)

Indian Standard

SPECIFICATION FOR ROTARY WAFER SWITCHES (LOW CURRENT RATING)

PART I TESTS AND GENERAL REQUIREMENTS

First Reprint DECEMBER 1980
(Incorporating Amendment No. 1)

UDC 621·316·542·2 : 023·4

© *Copyright* 1980

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1980

Indian Standard

SPECIFICATION FOR ROTARY WAFER SWITCHES (LOW CURRENT RATING)

PART I TESTS AND GENERAL REQUIREMENTS

Electronic Components Sectional Committee, ETDC 25

Chairman	*Representing*
Shri T. V. Ramamurti	National Physical Laboratory (CSIR), New Delhi
Members	
Dr S. S. S. Agarwala	Central Electronics Engineering Research Institute (CSIR), Pilani
Shri B. L. Aggarwal	Small Scale Manufacturer (Pioneer Electric Corporation, Agra)
Shri B. Balaramaswamy	Research & Development Organization (Ministry of Defence)
Shri P. K. Saha (*Alternate*)	
Shri P. N. Deobhakta	Department of Technical Development, Government of India
Shri A. N. Mukherjee (*Alternate*)	
Shri N. V. Gadadhar	Wireless Adviser, Department of Posts & Telegraphs
Shri K. R. K. Iyengar (*Alternate*)	
Wg Cdr G. S. Malhan	Directorate of Technical Development & Production (Air) (Ministry of Defence)
Shri H. S. Bhattacharya (*Alternate*)	
Shri S. S. Matharu	All India Radio Merchants' Association, Bombay
Shri H. J. Mirchandani	Indian Telephone Industries Ltd, Bangalore
Shri A. Mitra	Directorate General of Supplies & Disposals (Ministry of Supply)
Cdr B. G. Mudholkar	Directorate of stores Production (Navy) (Ministry of Defence)
Lt Cdr O. P. Sehgal (*Alternate*)	
Shri P. R. Mulchandani	Mulchandani Electrical and Radio Industries Ltd, Bombay
Shri B. N. Prakash	Radio and Electrical Manufacturing Co Ltd, Bangalore
Shri H. V. Ananthanarayana (*Alternate*)	
Shri A. S. Rao	Atomic Energy Establishment, Bombay
Shri U. V. Warlu (*Alternate*)	
Dr Saroj Datta	Radio Construction Wing, Directorate General of Civil Aviation (Ministry of Transport)
Shri S. R. Nirody (*Alternate*)	

(*Continued on page* 2)

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

(*Continued from page* 1)

Members	*Representing*
Shri P. L. Sehgal	Development Commissioner, Small Scale Industries, New Delhi
Shri R. Seshasayee	Telecommunication Research Centre, Posts & Telegraphs Department
Shri C. R. Subramanian	Bharat Electronics Ltd, Bangalore
Shri K. R. Thakar (*Alternate*)	
Shri S. Kumar (*Alternate*)	
Shri P. Suryanarayana	National Ekco Radio & Engineering Co Ltd, Bombay
Shri K. N. Tiwari	Chief Inspectorate of Electronics (Ministry of Defence), Bangalore
Shri R. K. Vaishampayan	Radio Manufacturers' Association of India, Calcutta
Shri S. Venkataraman	Philips India Ltd, Calcutta
Shri Y. S. Venkateswaran, Deputy Director (Electrotechnical)	Director, ISI (*Ex-officio Member*)

Secretary

Shri S. Srinivasan
Assistant Director (Electrotechnical), ISI

Electromechanical Components Subcommittee, ETDC 25 : 3

Convener	
Shri K. N. Tiwari	Chief Inspectorate of Electronics (Ministry of Defence), Bangalore
Members	
Shri P. R. Mulchandani	Mulchandani Electrical and Radio Industries Ltd, Bombay
Shri B. N. Prakash	Radio and Electricals Manufacturing Co Ltd, Bangalore
Shri Purushottam Lal	Atomic Energy Establishment, Bombay
Shri A. B. Roy	Philips India Ltd, Calcutta
Shri N. S. Sathyanarayanan	Indian Telephone Industries Ltd, Bangalore
Shri C. L. Sharma	M. C. Engineering Co, New Delhi
Shri C. K. Srinivas	Bharat Electronics Ltd, Bangalore

Indian Standard

SPECIFICATION FOR ROTARY WAFER SWITCHES (LOW CURRENT RATING)

PART I TESTS AND GENERAL REQUIREMENTS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 31 January 1964, after the draft finalized by the Electronic Components Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The object of this standard is to establish uniform requirements for the electrical, mechanical and climatic properties as well as safety aspects, test methods, interchangeability and compatibility of rotary wafer switches of low current rating generally used in electronic and telecommunication equipment.

0.3 Part I of this standard is confined to general requirements and methods of measurement. Further parts will contain article sheets and order forms for different types of switches.

0.4 This standard is largely based on the corresponding recommendation of the International Electrotechnical Commission (IEC) as contained in Pub 132-1 (1962)-Part I Rotary Wafer Switches (Low Current Rating) Part I : General Requirements and Measuring Methods except that some of the test methods have been simplified. The grading (*see* **3**) specified in this standard is based mainly on use at high frequencies and this is an addition to IEC recommendation.

0.5 This standard requires reference to IS : 589-1961 Basic Climatic and Mechanical Durability Tests for Electronic Components (*Revised*), so far as the details of the climatic and mechanical testing procedures are concerned; only the relevant degrees of severity and the performance requirements have been specified in this standard.

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960 Rules for Rounding Off Numerical Values (*Revised*).

0.7 This standard is intended chiefly to cover the technical requirements relating to rotary wafer switches of low current rating, and it does not include all the necessary provisions of a contract.

1. SCOPE

1.1 This standard (Part I) prescribes methods of tests and requirements for judging the mechanical, electrical and climatic properties of rotary wafer switches intended for use in electronic and telecommunication equipment and designed for rated currents of 5A or less and for rated voltage of 1 000 V or less.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 **Wafer** — A switch element comprising two parts, a fixed disc (stator) carrying contact clips or contacts and a rotating disc carrying rotor blades or rotor contacts capable of connecting contact clips or contacts of the fixed disc, in various combinations.

2.2 **Rotor Blades** — Metallic segments carried by the rotor and shaped to engage with the contact clips on the stator as required.

2.3 **Contact Clips** — Metallic items carried by the stator which at one end makes contact with the rotor blades carried by the rotor and which, at the other end, is provided with soldering terminations.

2.4 **Pole**—A contact clip capable of being connected to a number of other clips. It makes continuous contact with the rotor blades. The number of poles on a given wafer is determined by the number of rotor blades.

2.5 **Way (or Position)**—A point of rest of the rotor with reference to the stator resulting in a particular circuit condition.

2.6 **Termination** — The part of the contact clip provided for connection to the external circuit.

2.6.1 *Dummy Termination* — Metallic item carried by the stator and having only a termination for connection to external circuit but having no means of making contact with the rotor blades.

2.6.2 *Straight Termination* — A termination which is straight and not bent.

2.6.3 *Forward Termination* — A termination which is bent away from the wafer.

2.6.4 *Reversed Termination* — A termination bent towards the wafer.

2.7 **Index Mechanism** – Mechanical device to locate and maintain each position of the rotor

2.8 **Mounting Plate**—An assembly provided with a bush and locating lug and which carries the entire switch, and provided for mounting it on a panel, usually an integral part of the index mechanism.

2.9 **Locating Lug** — A projection provided on the mounting plate to prevent undue rotation of the switch assembly during operation

2.10 **Shield**—An electrical screening plate usually similar in shape and size to the wafer and which may be mounted between adjacent wafers

2.11 **Strap**—An item which may be fitted to the contact face of a wafer Its purpose is to retain the rotor in position and to prevent side-play. It is normally used in conjunction with ceramic wafers but may also be used with laminate wafers when an additional bearing is required.

2.12 **Double Sided Wafer**—A wafer provided with terminations on both sides, normally mounted together by securing rivets or eyelets (*see* **2.13**). The opposite terminations may be either electrically connected or insulated.

2.13 **Eyelet Insulator** — An insulator which isolates the terminations on the opposite sides of a double sided wafer (The terminations shall be restricted to a maximum potential of 100 V)

2.14 **Shorting Blade**—A rotor blade projection which maintains connection with one contact clip until the next contact is made.

2.15 **Non-shorting Blade** – A rotor blade projection which breaks one connection before the next is made

2.16 **Rotor Retaining Ring**—A ring employed in addition to the rotor blade on the opposite sides

2.17 **End Stop**—A means to prevent the spindle from rotating beyond a certain limit in either direction

2.18 **Clearance**—The shortest distance measured in air between conductive parts

2.19 **Creepage Distance**—The shortest distance between conductive parts over the outer surface of insulation with the switch in any position

2.20 **Electrical Rating**—Electrical rating of a swich is given by the combination of voltage and current under which the switch contact shall operate satisfactorily in specified circuit conditions and at standard atmospheric conditions for testing.

2.21 Maximum Voltage—The highest voltage specified in the relevant article sheet from which the test voltage for voltage proof test is derived.

2.22 Maximum Current—The current which each contact of the switch is capable of carrying continuously. (It is not required to interrupt this current.)

2.23 Type Tests—Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general qualities and design of a given type of switch.

2.24 Acceptance Tests—Tests carried out on samples selected from a lot for purposes of verifying the acceptability of the lot.

2.24.1 *Lot*—All switches of the same type, grade, category and rating manufactured by the same factory during the same period.

2.25 Routine Tests—Tests carried out on each switch to check requirements which are likely to vary during production.

3. GRADES AND CATEGORIES

3.1 Grades—The following two grades shall be considered standard for the type of rotary wafer switches covered in this specification:

Grade 1	Switches having low loss at high frequency (*see* **9.6**), and
Grade 2	Switches other than those covered by Grade 1.

3.2 Categories—The switches shall be divided into the following three categories based on their climatic durability:

CLIMATIC TEST (*see* IS : 589-1961)	SEVERITY		
	Category I	Category II	Category III
Dry heat	100°C	85°C	70°C
Cold	−55°C	−40°C	−10°C
Damp heat (long term)	84 days	84 days	28 days
Damp heat (accelerated)	6 cycles	6 cycles	2 cycles
Rapid change of temperature	+100°C to −55°C	+85°C to −40°C	Not applicable
Low air pressure	44 mbar	300 mbar	600 mbar

NOTE 1 —Generally, Grade 1 switches will be of Categories I and II, and Grade 2 switches of Category III.

NOTE 2—In case of special requirements where the above categories cannot be applied, different combinations of climatic severities may be agreed to between the purchaser and the supplier, provided that the degrees of severity are chosen from those specified in IS : 589-1961.

4. ELECTRICAL RATINGS

4.1 The relevant article sheet of the switch shall specify:

a) Maximum voltage,
b) Maximum current, and
c) Circuit conditions and associated combinations of voltage and current.

5. MATERIALS AND WORKMANSHIP

5.1 Materials—The switches shall be constructed from the most suitable materials which shall be free from flaws and which shall not be susceptible to mutual chemical action over the entire range of temperature for which the switches are designed.

5.2 The spindle and index mechanism shall be served on assembly with an approved lubricant which shall be suitable for the temperature range of the switch.

5.3 Workmanship—All parts of the switch shall be manufactured in a thoroughly workmanlike manner, and in accordance with the current practice.

6. MARKING

6.1 Each switch shall be clearly marked with the following information:

a) Manufacturer's name and trade-mark;
b) Manufacturer's type number; and
c) Any additional marking, if required by the purchaser.

6.1.1 The manufacturer's catalogue for the switch shall contain information about the grade, category, sealed or unsealed, details of index mechanism and reference to relevant article sheet.

6.2 The switches or their cartons may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. CONDITIONS FOR TESTS

7.1 General

7.1.1 The tests shall be carried out on the switches as received from the manufacturer or supplier. In no case shall the contact parts be cleaned or otherwise prepared prior to the tests unless explicitly so agreed.

7.1.2 Where mounting is specified in a test, the switches shall be rigidly mounted on a metal plate using its normal fixing device, the dimensions of the plate being such that the contour of the specimen under test is exceeded.

7.2 Selection of Samples—The samples for testing shall be so selected as to be representative of the lot.

7.3 Atmospheric Condition for Testing—Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions specified in IS : 589-1961 Basic Climatic and Mechanical Durability Tests for Electronic Components (*Revised*).

7.4 Preconditioning—Before measurements are made, the switches shall be stored at the measuring temperature for a time sufficient to allow the entire switch to reach that temperature The recovery period called for after conditioning is adequate for this purpose.

7.5 Correction to be Applied — When measurements are made at an ambient temperature other than the reference temperature, the results shall, where necessary, be corrected to that temperature. The ambient temperature during the test shall be stated in the test report.

7.6 Other Precautions—During measurements, the switches shall not be exposed to draughts, direct sun rays or other influences likely to cause errors.

8. VISUAL EXAMINATION AND DIMENSIONS

8.1 Visual Examination

8.1.1 The marking shall be in accordance with **6.**

8.1.2 The switches shall be complete, and the workmanship and finish shall be satisfactory.

8.1.3 The contact operating sequence shall be satisfactory and the lubrication shall be in accordance with **5.2.**

8.1.4 Each locking nut shall have a well-formed full thread and shall be a good running fit on the fixing bush.

8.1.5 The index mechanism shall have a positive locating action.

8.1.6 There shall be no deterioration (in the features mentioned in **8.1.1** to **8.1.5**) after electrical, mechanical and climatic tests.

8.2 Dimensions — The dimensions of the switch shall be checked and shall be in accordance with those specified for in the relevant article sheet for the type under test.

9. ELECTRICAL TESTS

9.1 Contact Resistance

9.1.1 The contact resistance may be measured either with DC or with AC.

9.1.2 The switches shall be fully operated three times on no-load before measurement. The contact resistance shall then be measured across each pair of terminations at a maximum current of one ampere and from a source whose open-circuit voltage does not exceed 2·5V.

9.1.3 The measuring apparatus shall be such as to ensure an accuracy of ±10 percent.

9.1.4 The contact resistance shall be measured between a maximum of any four pairs of terminations selected at random, but at least one pair shall be selected for each rotor blade.

9.1.5 All subsequent measurement of contact resistance, after various other tests, shall be repeated on the same pair of contacts as selected in **9.1.4**.

9.1.6 The value of the contact resistance shall not exceed that specified in the relevant article sheet.

9.2 Insulation Resistance

9.2.1 The insulation resistance shall be measured after electrification for one minute by a DC potential of 100 V or 500 V as specified in the relevant article sheet.

9.2.2 The switches shall be mounted as specified in **7.1.2** and the insulation resistance measured between the following points:

a) Mounting plate and all parts intended to be electrically insulated from it connected together, and

b) Two adjacent terminations having minimum spacing and intended to be electrically insulated from each other.

NOTE—A minimum of two pairs of adjacent terminations shall be chosen on each wafer for this measurement.

9.2.3 All subsequent measurements of insulation resistance after various other tests, shall be repeated on the same pair of terminations as those stated in **9.2.2**.

9.2.4 The value of the insulation resistance shall be not less than that specified in the relevant article sheet for the category and grade under consideration.

9.3 Voltage Proof

9.3.1 The switches shall be mounted in the normal manner as specified in **7.1.2** and three times the peak working voltage as specified under ' Electrical Rating' in the relevant article sheet shall be applied for one minute between the terminations chosen for the test as in **9.2.2**.

9.3.2 The switches shall withstand the application of the voltage without breakdown or flashover.

9.4 Corona

9.4.1 The switches shall be mounted as specified in **7.1.2** and a test voltage as specified in **9.4.2** applied between the terminations indicated in **9.2.2** for five minutes in each case.

9.4.2 The applied voltage shall have a frequency between 40 c/s and 60 c/s and it shall be increased gradually until discharge occurs. In order to determine the ' extinction voltage ', the test voltage shall be decreased gradually until no discharge occurs. The value of the voltage shall then be recorded. This voltage shall be not less than the test voltage required in **9.3**.

9.4.3 A schematic diagram of a circuit for this measurement is given in Fig. 1.

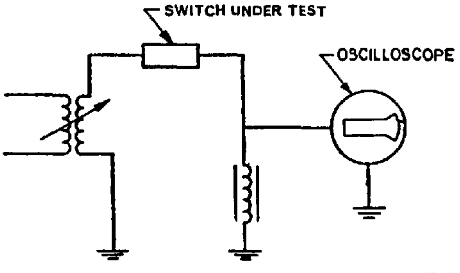

FIG. 1 CIRCUIT ARRANGEMENT FOR CORONA TEST

9.4.4 The frequency of parallel resonance determined by the inductance of the choke coil and all capacitance (such as cable capacitance to earth, input capacitance of cathode ray tube, capacitance of connecting wires to earth, etc) shall be between 0 1 Mc/s and 1 Mc/s, and at this frequency the impedance of the circuit measured from the input terminals of the oscilloscope shall be not less than 0 1 megohm. The resistance of the choke coil shall be sufficiently low so as to avoid interference from the 40 to 60 c/s signal at maximum sensitivity of the cathode ray tube. The oscilloscope shall have a sensitivity in the frequency range up to 1 Mc/s such that corona voltages of 50 μV can be clearly distinguished, and its input impedance shall be not less than 1 megohm.

9.5 Capacitance

9.5.1 The switches shall be mounted as specified in **7.1.2**

9.5.2 The capacitance shall be measured between:

a) one termination not connected to the rotor blade and all other terminations connected together and to the frame (*see* Fig. 2A);

b) one termination connected to the rotor blade and all other terminations connected together and to the frame (*see* Fig. 2B);

c) two terminations connected to the rotor blade of the same wafer and all other terminations connected together and to the frame (*see* Fig. 2C);

d) two adjacent terminations not connected to the rotor blade and having minimum spacing and all other terminations connected together and to the frame (*see* Fig. 2D); and

e) in the case of switches with insulated spindles, all terminations connected together and the spindle connected to the frame (*see* Fig. 2E).

9.5.3 Unless otherwise specified, the capacitance shall be measured at 1 Mc/s between the contacts specified in the relevant article sheet.

9.5.4 The value of the capacitance as measured between the specified terminations shall not exceed the limits laid down in the relevant article sheet.

9.6 Radio Frequency Shunt Resistance — (Applicable to Grade 1 switches only.)

9.6.1 The RF shunt resistance shall be measured at the frequency specified in the relevant article sheet between two contacts as detailed in the article sheet.

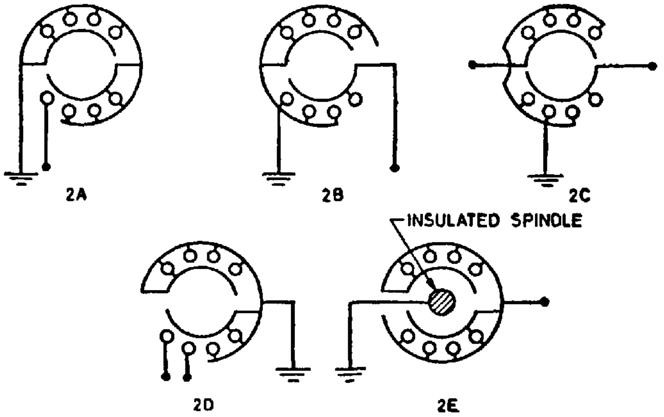

FIG. 2 CONTACT FOR CAPACITANCE MEASUREMENTS

9.6.2 The measuring method shall be chosen so as to ensure an accuracy better than ±10 percent.

9.6.3 The value of RF shunt resistance shall be not less than that specified in the relevant article sheet.

10. MECHANICAL TESTS

10.1 Rotational Torque

10.1.1 The switches shall be mounted rigidly as specified in **7.1.2**.

10.1.2 The torque necessary to rotate the spindle from one position to another throughout the entire range either in a clockwise or anti-clockwise direction shall be measured.

10.1.3 The rotational torque shall be within the limits specified in the relevant article sheet.

10.2 End Stop Torque

10.2.1 The switches shall be mounted rigidly in the normal manner as specified in **7.1.2**.

10.2.2 A torque of value as specified in the relevant article sheet shall be applied to the spindle for one minute in each of the end positions.

10.2.3 There shall be no permanent deformation or loosening of the stops nor shall there be any slipping or yielding of parts.

10.3 Index Mechanism

10.3.1 The switches shall fall into any appropriate position when placed within an angle from that position as specified in the relevant article sheet.

10.4 Robustness of Terminations

10.4.1 *Tensile Test* — This test shall be carried out in accordance with **7.19.1** of IS : 589-1961 Basic Climatic and Mechanical Durability Tests for Electronic Components (*Revised*) in a tangential position in the plane of the wafer and with a load as specified in the relevant sheet applied in each direction. There shall be no sign of fracture, loosening of parts, movements relative to the body of the switch or any other mechanical failure.

10.4.2 *Bending Test* — This test shall be carried out in accordance with **7.19.2** of IS : 589-1961 for two bends. There shall be no sign of fracture, loosening of parts, movements relative to the body of the switch or any other mechanical failure.

10.5 Soldering

10.5.1 The switches shall be subjected to the soldering test in accordance with **7.18** of IS : 589-1961.

10.5.2 The method of test (that is, Method 1 or Method 2), size of soldering bit in case of Method 2 and period of recovery shall be as specified in the relevant article sheet.

10.5.3 After the test, the switches shall be visually examined and there shall be no fracture, loosening of parts or any other mechanical failure.

10.6 Vibration

10.6.1 The switches shall be mounted in the normal manner on a vibration table and connected in a circuit with a suitable device such as a lamp which will indicate momentary spurious operations during the test.

NOTE—In choosing the circuit and the lamp, care shall be taken to ensure that the electrical ratings of the switch under test are not exceeded.

10.6.2 The switches shall be subjected to the vibration test in accordance with **7.6** of IS : 589-1961.

10.6.3 There shall be no spurious operation, no loosening of parts, or any other mechanical failure. The fixing shall not become loose.

10.6.4 The contact resistance shall be measured as in **9.1** after the test and the values shall not exceed the limits specified in the relevant article sheet.

10.7 Bumping

10.7.1 The switches shall be mounted on the table of a bump test machine and connected in a circuit as mentioned in **10.6.1.**

10.7.2 The switches shall be subjected to the bump test in accordance with **7.5.1** of IS . 589-1961.

10.7.3 There shall be no spurious operation, no fracture or loosening of parts, or other mechanical failure. The fixing shall not become loose.

10.7.4 The contact resistance shall be measured as in **9.1** after the test and the values shall not exceed the limits specified in the relevant article sheet.

11. CLIMATIC TESTS

11.1 Preconditioning—The switches shall be preconditioned as specified in **7.4.**

11.2 Dry Heat Test

11.2.1 The switches shall be subjected to the dry heat test in accordance with **7.2** of IS : 589-1961.

11.2.2 The temperature of the test chamber shall be maintained at the appropriate maximum value for the category. At the end of the period of conditioning and while still at the high temperature, the insulation resistance shall be measured.

11.2.3 The value of the insulation resistance shall be not less than that specified in the relevant article sheet.

11.2.4 While at the high temperature, the switches shall be mechanically operable.

11.2.5 The switches shall then be removed from the dry heat chamber and allowed to remain under standard recovery conditions.

11.3 Damp Heat (Accelerated) First Cycle

11.3.1 This test shall be carried out in accordance with **7.4** of IS : 589-1961.

11.3.2 After the specified period of conditioning, the switches shall be removed from the chamber and allowed to recover under conditions appropriate to the test and then visually examined.

11.3.3 There shall be no visible damage to the switch. The markings shall be legible and indelible.

11.4 Cold Test

11.4.1 This test shall be carried out in accordance with **7.1** of IS : 589-1961.

11.4.2 The temperature of the chamber shall be appropriate to the category of the switch under test and the duration of the exposure shall be two hours

11.4.3 Immediately after the conditioning period, the switches shall be removed from the chamber and the rotational torque determined in accordance with **10.1**.

11.4.4 The value of the torque shall be between the limits specified in the relevant article sheet.

11.4.5 The capacitance shall be measured in accordance with **9.5** and shall be within the limits specified in the relevant article sheet

11.4.6 In the case of Grade 1 switches, the RF shunt resistance shall be measured in accordance with **9.6** and shall be within the limits specified in the relevant article sheet.

11.5 Low Air Pressure Test

11.5.1 The switches shall be subjected to the low air pressure test in accordance with **7.12** of IS : 589-1961.

11.5.2 The test chamber shall be maintained at a temperature of 15° to 35°C and at a pressure appropriate to the category of the switch and the duration of the test shall be five minutes During the conditioning, a DC or AC (peak) potential of twice the rated maximum working voltage shall be applied between the points mentioned in **9.2.2** For eyelet insulators, the voltage shall be 100 V.

11.5.3 There shall be no sign of glow discharge, breakdown, flashover or harmful deformation of the switch

11.6 Damp Heat (Accelerated) Remaining Cycles

11.6.1 The switches shall be subjected to the test in accordance with **7 4** of IS 589-1961 for the remaining number of cycle (s) appropriate to the category of the switch

11.6.2 At the end of the specified number of cycles, the switches shall be removed from the chamber and allowed to recover under recovery conditions appropriate to this test.

11.6.3 The switches shall then be subjected to the following tests in the order indicated:

a) *Contact Resistance* (*see* **9.1**) — The contact position of the switches shall not be disturbed prior to the first measurement of contact resistance after exposure.

b) *Insulation Resistance* (*see* **9.2**) — The insulation resistance value shall be not less than those specified in the relevant article sheet.

c) *Voltage Proof* (*see* **9.3**) — The switches shall withstand the test without any breakdown.

d) *RF Shunt Resistance* (*For Grade 1 Only*) (*see* **9.6**)—The values shall be not less than that specified in the relevant article sheet

e) *Capacitance* (*see* **9.5**)—The value shall not exceed those specified in the relevant article sheet.

f) *Rotational Torque* (*see* **10.1**) — The value of the torque shall be within the limits specified in the relevant article sheet.

11.6.4 The switches shall then be allowed to remain under standard recovery conditions for a total period of 24 hours from the time of removal from the test chamber and shall then be subjected to the insulation resistance test (*see* **9.2**). The value of the insulation resistance shall be not less than that specified in the relevant article sheet.

11.6.5 The switches shall also be visually examined and there shall be no visible mechanical deterioration. The marking shall be legible and indelible

11.7 Damp Heat (Long Term Exposure)

11.7.1 The switches shall be subjected to this test in accordance with **7.3** of IS 589-1961 Basic Climatic and Mechanical Durability Tests for Electronic Components (*Revised*).

11.7.2 The duration of the exposure shall be appropriate to the category of the switch.

11.7.3 At the end of the period of exposure, the switches shall be removed from the chamber and allowed to remain under recovery conditions appropriate to this test

11.7.4 The switches shall then be subjected to the tests specified in **11.6.3** and shall meet corresponding requirements of the relevant article sheet

11.8 Rapid Change of Temperature—(Applicable to Categories I and II only)

11.8.1 The switches shall be subjected to this test in accordance with **7.4** of IS : 589-1961.

11.8.2 The maximum and minimum temperature shall be appropriate to the category of the switch. The total number of cycles shall be five.

11.8.3 After the exposure, the switches shall be removed from the chamber and allowed to remain under recovery conditions appropriate to this test

11.8.4 The switches shall then be subjected to the tests mentioned in **11.6.3.** The values, after these tests, shall not have changed from the original values.

11.9 Sealing — (for sealed switches only).

11.9.1 *Sealing (Normal)*

11.9.1.1 This test shall be carried out in accordance with **7.15.2** of IS : 589-1961.

11.9.1.2 The rate of leakage of air shall not exceed that specified in the relevant article sheet.

11.9.2 *Sealing (Extended)*

11.9.2.1 This test shall be carried out in accordance with **7.15.3** of IS : 589-1961.

11.9.2.2 The rate of leakage of air shall not exceed that specified in the relevant article sheet.

11.10 Salt Mist Test

11.10.1 The switches shall be subjected to this test in accordance with **7.10** of IS : 589-1961, the period of exposure being four days.

11.10.2 The switches shall be mounted normally as specified in **7.1.2** for this test.

11.10.3 After the specified period of exposure, the switches shall be allowed to recover under the recovery conditions appropriate to this test.

11.10.4 The switches shall then be subjected to the test mentioned in **11.6.3** and shall meet the appropriate requirements as laid down in the relevant article sheet.

11.11 Mould Growth Test

11.11.1 The switches shall be subjected to this test in accordance with **7.9** of IS : 589-1961.

11.11.2 After the expiry of the specified period of exposure, there shall be no mould growth on the switches visible to the naked eye.

11.12 Dust Test — Under consideration.

12. ENDURANCE TEST

12.1 This test shall be carried out at the appropriate maximum category temperature for 10 000 cycles at the rate of not less than 5 cycles per minute and not more than 15 cycles per minute.

12.2 Each cycle shall consist of rotating the spindle from the extreme anti-clockwise position through the entire range and returned to the extreme anti-clockwise position.

12.3 The coupling between the driving mechanism and the switch shall not influence the proper working of the index mechanism.

12.4 The terminations which are to be tested shall be inserted in either of the following two circuits:

a) *Resistive Circuit* — The test shall be carried out with DC. The value of the voltage and current shall be as specified in the relevant article sheet.

b) *Inductive Circuit* — The test shall be carried out with AC current at a frequency of 40 to 60 c/s. The values of the voltage and current shall be as specified in the relevant article sheet. The circuit shall have a power factor between 0·7 and 0·8.

12.5 At the conclusion of the required number of cycles, the switches shall be removed from the chamber and allowed to recover under recovery conditions appropriate to this test.

12.5.1 The switches shall then be subjected to damp heat (accelerated) test in accordance with **7.4** of IS : 589-1961 for 2 cycles.

12.5.2 At the end of the two cycles, the switches shall be removed from the chamber and allowed to recover under the recovery conditions appropriate to this test.

12.5.3 The switches shall then be subjected to the following tests in the order indicated:

a) Contact resistance,
b) Rotational torque,
c) Voltage proof, and
d) RF shunt resistance (for Grade 1 switches only).

12.6 The switches shall then be visually examined. There shall be no visible mechanical deterioration. The marking shall be legible and indelible.

13. CLASSIFICATION OF TESTS

13.1 Type Tests (*see* **2.23**)—The procedure for type tests shall be in accordance with IS : 2612-1965 Recommendation for Type Approval and Sampling Procedures for Electronic Components.

13.1.1 *Number of Samples* — The minimum number of samples for type tests shall be 24 of each category and grade pertaining to the relevant article sheet.

13.1.2 *Sequence of Type Tests* — The sequence of tests for type approval shall be in accordance with Appendix A.

13.2 Routine Tests (*see* **2.25**)

13.2.1 Each and every switch shall be subjected to visual examination as specified in **8.1** and shall comply with the requirements laid down there in.

13.3 Acceptance Tests (*see* **2.24**)

13.3.1 Acceptance tests shall be carried out on a limited number of samples selected in accordance with the sampling procedure given in IS : 2612-1965 Recommendation for Type Approval and Sampling Procedures for Electronic Components.

13.3.2 The samples shall be divided into two groups and the switches in each group shall be subjected to tests as follows:

Group A

a) Voltage proof,
b) Contact resistance,
c) Insulation resistance,
d) Sealing normal (for sealed types only), and
e) Operating force.

Group B

a) General examination,
b) Dimensions,
c) End stop torque,
d) RF shunt resistance,
e) Soldering,
f) Robustness of terminations, and
g) Bumping.

APPENDIX A

(*Clause* 13.1.2)

SEQUENCE OF TYPE TESTS

All 24 Samples
Visual Examination
Dimensions
Contact Resistance
Insulation Resistance
Voltage Proof
Capacitance (Grade 1 Only)
Sealing, Normal (for Sealed Type Only)

First Lot (4 Samples)	Second Lot (4 Samples)	Third Lot (4 Samples)	Fourth Lot (8 Samples)	Fifth Lot (4 Samples)
Rotational Torque	Climatic Sequence	Damp Heat (Long Term)	Endurance	Sealing Extended (for Sealed Type Only)
End Stop Torque	Sealing, Normal (*for Sealed* Type Only)	Sealing, Normal (for Sealed Type Only)	Corona	Mould Growth
Index Mechanism	Salt mist		Sealing, Normal (for Sealed Type Only)	
Robustness of Terminal				
Soldering				
Vibration				
Bumping				
Rapid Change of Temperature				
Sealing, Normal (for Sealed Type Only)				
Dust				